CFEL SCIENCE

SEMINAR

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CFEL – Building 99, seminar room I and II (ground floor)

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Ultrahigh density spin-polarized hydrogen for ultrafast applications, and cavity-based chiral polarimetry

I describe the recent production of ultrahigh pulsed densities of spin-polarized H (SPH) and D (SPD) atoms reaching 10^{20} cm^{-3} (which is about 8 orders of magnitude higher than continuous production methods), from the photodissociation of hydrogen halides, and the detection through magnetization quantum beats using a pickup coil [1]. This new regime of ultrahigh SPH/SPD density opens the possibility for at least three novel applications: (a) the production intense spin-polarized electron or proton beams [2], which is projected to have fluxes up to 4 orders of magnitude higher than current sources [3]; (b) the preparation of nuclear-spin-polarized molecules; and (c) the demonstration of spin-polarized D-T or D-^{3}He laser fusion at large laser facilities (such as NIF), for which a reactivity enhancement of 50% is expected [1].

In a separate topic, I describe the measurement of chiral optical rotation using a bow-tie cavity, for which we demonstrate three important improvements: (a) the enhancement of the chiral signals by the number of the cavity passes (typically >100); (b) the suppression of birefringent backgrounds; and (c) the ability to reverse the sign of the chiral signals rapidly, allowing the isolation of the chiral signals from backgrounds. We have demonstrated the measurement of chiral optical rotation in high-noise environments, such as for open-air gas samples, and for chiral liquids in the evanescent wave produced by total internal reflection at a prism surface [4]. We discuss recent progress in sensitivity improvement, and new fields of application of chiral sensing, including new parity nonconservation measurement schemes in atoms and molecules.

[1] D. Sofikitis, V. Kannis, G. Boulogiannis, T. P. Rakitzis, *Phys. Rev. Lett.* **121**, 083001 (2018).

[2] Wu et al., *New J. Phys.* **21**, 073052 (2019).

[3] M. Wan, M. Tamburini, C. H. Keitel, *Phys. Rev. Lett.* **122**, 214801 (2019).

[4] D. Sofikitis, L. Bougas, A. Spiliotis, G. Katsoprinakis, B. Loppinet, T. P. Rakitzis, *Nature* **514**, 76 (2014).

Host: Jochen Küpper/ CFEL Molecular and Ultrafast Science Seminar